# CONTENTS


**11 Characterisation of dusts and sludges generated during stainless steel production in Brazilian industries**
P. J. Nolasco-Sobrinho, D. C. R. Espinosa and J. A. S. Tenório

**18 Modelling and simulation of syngas unit in large scale direct reduction plant**
F. Farhadi, M. Y. Motamed Hashemi and M. Bahrami Babaheidari

**25 Pellet phase changes during reduced iron production by rotary kiln processes**
V. K. Trujić and D. T. Živković

**36 Physical modelling of slag splashing in converter**
C.-J. Liu, Y.-X. Zhu and M.-F. Jiang

**43 Laboratory investigation of denitrogenation of low carbon steel by gas generation *in situ***
R. Sau, N. N. Jha and A. Paul

**48 Analysis of flow, heat transfer, solidification, and inclusion removal in continuous slab caster by finite element method**
C. H. Moon and S. M. Hwang

**57 Advantage of anticlogging nozzles over conventional aluminographite nozzles in continuous casting of steel slabs**
S. Devic, R. Galjak and T. Bradaric

**61 Cold model study of raceway under mixed particle conditions**
G. S. S. R. K. Sastry, G. S. Gupta and A. K. Lahiri

**66 Determination of macroinclusions during clean steel production**
J. Cheng, R. Eriksson and P. Jönsson

**73 Influence of ferromanganese additions on microalloyed engineering steel**
T. Sjökvist, M. Göransson, P. Jönsson and P. Cowx


---

*Selection of refereed papers from Clean Steel 6, held in Balatonfured, Hungary in June 2002*


**95 Non-metallic inclusion entrapment by slags: laboratory investigation**
P. Rocabois, J. Lehmann, C. Gatellier and J. P. Teres

**101 Reoxidation during ladle treatment**
B. Coletti, B. Gommers, C. Vercruyssen, B. Blanpain, P. Wollants and F. Haers

**106 Nucleation and growth kinetics of inclusions during liquid steel deoxidation**
Lifeng Zhang and W. Pluschkell

**111 Thermodynamic examination of inclusion modification and precipitation from calcium treatment to solidified steel**
L. Holappa, M. Hämäläinen, M. Liukkonen and M. Lind

**116 Deep steel desulphurisation technology in ladle furnace at KSC**
D. Takahashi, M. Kamo, Y. Kurose and H. Nomura

**120 Behaviour of inclusions in RH vacuum degasser**
C. J. Treadgold

**125 High purity steels: a challenge to improved steelmaking processes**
H. Lachmund and Y. Xie

**130 Improving oxide cleanness on basis of MIDAS method**
H. Jacobi and K. Wünnenberg

**142 Cleanness assessment of high quality steels produced by RH treatment**
V. Tusset, Ch. Marique, H. Mathy, B. Gommers and N. Van Poeck

**146 Some aspects of behaviour of calcium in silicon killed steels**
W. Tiekink, R. van den Bogert, T. Breedijk and A. Ferguson

**151 Simulation of coagulation of non-metallic inclusions in tundish and their trapping into solidified shell in continuous casting mould**
W. Yamada, A. Kiyose, J. Fukuda, H. Tanaka and J.-I. Nakashima

**158 Steel cleanness requirements for X65 to X80 electric resistance welded linepipe steels**
I. D. Simpson, Z. Tritsiniotis and L. G. Moore

**165 Metallurgy of plastic inclusions to improve fatigue life of engineering steels**
C. Bertrand, J. Molinero, S. Landa, R. Elvira, M. Wild, G. Barthold, P. Valentin and H. Schifferl


---


**170 Reduction and melting model of carbon composite iron pellets**
S. Meissner, I. Kobayashi, Y. Tanagaki and K.-H. Tacke

**195 Effects of process conditions on mixing between molten iron and slag in smelting reduction vessel via water model study**
J.-M. Chou, M.-C. Chuang, M.-H. Yeh, W.-S. Hwang, S.-H. Liu, S. T. Tsai and H.-S. Wang

**203 Dissolution of iron oxide containing doloma in model basic oxygen furnace slag**
Y. Satyoko, W. E. Lee, E. Parry, P. Richards and I. G. Houldsworth

**209 Physical modelling of fluid flow in electric arc furnace caused by impinging gas jets**
V. Whitney

# CONTENTS


**11 Characterisation of dusts and sludges generated during stainless steel production in Brazilian industries**
P. J. Nolasco-Sobrinho, D. C. R. Espinosa and J. A. S. Tenório

**18 Modelling and simulation of syngas unit in large scale direct reduction plant**
F. Farhadi, M. Y. Motamed Hashemi and M. Bahrami Babaheidari

**25 Pellet phase changes during reduced iron production by rotary kiln processes**
V. K. Trujić and D. T. Živković

**36 Physical modelling of slag splashing in converter**
C.-J. Liu, Y.-X. Zhu and M.-F. Jiang

**43 Laboratory investigation of denitrogenation of low carbon steel by gas generation *in situ***
R. Sau, N. N. Jha and A. Paul

**48 Analysis of flow, heat transfer, solidification, and inclusion removal in continuous slab caster by finite element method**
C. H. Moon and S. M. Hwang

**57 Advantage of anticlogging nozzles over conventional aluminographite nozzles in continuous casting of steel slabs**
S. Devic, R. Galjak and T. Bradaric

**61 Cold model study of raceway under mixed particle conditions**
G. S. S. R. K. Sastry, G. S. Gupta and A. K. Lahiri

**66 Determination of macroinclusions during clean steel production**
J. Cheng, R. Eriksson and P. Jönsson

**73 Influence of ferromanganese additions on microalloyed engineering steel**
T. Sjökvist, M. Göransson, P. Jönsson and P. Cowx


---

*Selection of refereed papers from Clean Steel 6, held in Balatonfured, Hungary in June 2002*


**95 Non-metallic inclusion entrapment by slags: laboratory investigation**
P. Rocabois, J. Lehmann, C. Gatellier and J. P. Teres

**101 Reoxidation during ladle treatment**
B. Coletti, B. Gommers, C. Vercruyssen, B. Blanpain, P. Wollants and F. Haers

**106 Nucleation and growth kinetics of inclusions during liquid steel deoxidation**
Lifeng Zhang and W. Pluschkell

**111 Thermodynamic examination of inclusion modification and precipitation from calcium treatment to solidified steel**
L. Holappa, M. Hämäläinen, M. Liukkonen and M. Lind

**116 Deep steel desulphurisation technology in ladle furnace at KSC**
D. Takahashi, M. Kamo, Y. Kurose and H. Nomura

**120 Behaviour of inclusions in RH vacuum degasser**
C. J. Treadgold

**125 High purity steels: a challenge to improved steelmaking processes**
H. Lachmund and Y. Xie

**130 Improving oxide cleanness on basis of MIDAS method**
H. Jacobi and K. Wünnenberg

**142 Cleanness assessment of high quality steels produced by RH treatment**
V. Tusset, Ch. Marique, H. Mathy, B. Gommers and N. Van Poeck

**146 Some aspects of behaviour of calcium in silicon killed steels**
W. Tiekink, R. van den Bogert, T. Breedijk and A. Ferguson

**151 Simulation of coagulation of non-metallic inclusions in tundish and their trapping into solidified shell in continuous casting mould**
W. Yamada, A. Kiyose, J. Fukuda, H. Tanaka and J.-I. Nakashima

**158 Steel cleanness requirements for X65 to X80 electric resistance welded linepipe steels**
I. D. Simpson, Z. Tritsiniotis and L. G. Moore

**165 Metallurgy of plastic inclusions to improve fatigue life of engineering steels**
C. Bertrand, J. Molinero, S. Landa, R. Elvira, M. Wild, G. Barthold, P. Valentin and H. Schifferl


---


**170 Reduction and melting model of carbon composite iron pellets**
S. Meissner, I. Kobayashi, Y. Tanagaki and K.-H. Tacke

**195 Effects of process conditions on mixing between molten iron and slag in smelting reduction vessel via water model study**
J.-M. Chou, M.-C. Chuang, M.-H. Yeh, W.-S. Hwang, S.-H. Liu, S. T. Tsai and H.-S. Wang

**203 Dissolution of iron oxide containing doloma in model basic oxygen furnace slag**
Y. Satyoko, W. E. Lee, E. Parry, P. Richards and I. G. Houldsworth

**209 Physical modelling of fluid flow in electric arc furnace caused by impinging gas jets**
V. Whitney

214 **Design, development and installation of a system for addition of oil–water emulsion on coal blend at coke oven, Durgapur steel plant**
S. Thirumalai Selvan, Y. Singh, M. S. Sengupta, N. K. Kakkar and S. Kumar

217 **Measurement of ladle slag oxygen activity using electrochemical sensor**
B. Coletti, S. Smets, B. Blanpain, P. Wollants, J. Plessers, C. Vercruyssen and B. Gommers

223 **Liquid $Al_2O_3$–CaO–MgO inclusion entrapment at delta ferrite intercellular boundaries during solidification**
Y. Wang and S. Sridhar

229 **Mathematical maximisation of minimum residence time for two strand continuous caster**
D. J. de Kock, K. J. Craig and C. A. Pretorius

235 **Optimisation of narrow face water slot design for Siderar slab casting mould**
B. G. Thomas, M. Langeneckert, L. Castellá, M. Dziuba, G. Di Gresia and W. Balante

240 **Optimisation of spiral forging process design for ensuring dimensional precision of forged round billets by three-dimensional rigid–plastic finite element analysis**
K. Tamura, J. Tajima and Y. Fukutome

249 **Predictability of Charpy impact toughness in thermomechanically controlled rolled (TMCR) microalloyed steels**
D. Bhattacharjee, C. L. Davis and J. F. Knott

265 **A thermomechanical model for simulation of carbon steel solidification in mould in continuous casting**
A. Marcandalli, C. Mapelli and W. Nicodemi

273 **Optimisation of continuous casting process using genetic algorithms: studies of spray and radiation cooling regions**
N. Chakraborti, R. S. P. Gupta and T. K. Tiwari

279 **Optimisation of cutting length of continuously cast strands**
H. Jacobi and K. Wünnenberg

287 **Modelling of temperature and stress profiles in oxygen sensors upon immersion into steel baths**
O. Volkova, M.-E. Vogel and D. Janke

293 **Behaviour of magnesia–carbon refractories in vacuum–oxygen decarburisation ladle linings**
S. Smets, S. Parada, J. Weytjens, G. Heylen, P. T. Jones, M. Guo, B. Blanpain and P. Wollants

301 **Regularities in thermodynamic properties of interoxide polymeric compounds**
E. T. Turkdogan

307 **Influence of coal weathering on coke quality**
R. Álvarez, J. L. G. Cimadevilla, C. Barriocanal, M. D. Casal, M. A. Díez, J. J. Pis and C. S. Canga

313 **Comparison of iron ore reduction in experimental blast furnace and laboratory scale simulation of blast furnace process**
J. Sterneland, M. A. T. Andersson and P. G. Jönsson

328 **Study of solid mushroom formation in direct iron ore smelting reduction process using low temperature water model**
Y. P. Hwang, C. M. Fan, Y. L. Chen, W. S. Hwang, I. G. Chen and S. H. Liu

341 **Studies by mathematical and physical modelling of fluid flow and inclusion removal phenomena in slab tundish for casting stainless steel using various flow control device designs**
C. M. Fan, R. J. Shie, and W. S. Hwang

348 **Determination of rolling load in liquid core reduction of continuously cast thin steel slab**
L. S. Bayoumi and G. M. Megahed

353 **Abnormal transient phenomena in the continuous casting process: Part 1**
G. Alvarez de Toledo, J. Ciriza and J. J. Laraudogoitia

360 **Abnormal transient phenomena in the continuous casting process: Part 2**
G. Alvarez de Toledo, J. Ciriza, J. J. Laraudogoitia and A Arteaga

369 **A model for calculating solubility of hydrogen in steel**
K. Randerson, H. C. Carey and K. Schomberg

379 **Structure–property changes during hardening and tempering of new ultra high strength medium carbon low alloy steel**
M. R. Suresh, I. Samajdar, A. Ingle, N. B. Ballal, P. K. Rao and P.P. Sinha

385 **Removal of tin from tin coated steel by chlorination in air**
F. Tailoka, R. V. Kumar and D. J. Fray

391 **Mechanism of chlorination of tin in air and its application to steel can recycling**
F. Tailoka, R. V. Kumar and D. J. Fray

396 **Form of fluorine in $Na_2O$–NaF–$SiO_2$ slags determined by infrared spectroscopy**
T. Sakamaki, T. Yagi and M. Susa

399 **Modelling of ferrosilicon smelting in submerged arc furnaces**
N. K. Batra

405 **Optimisation of open die forging condition and tool design**
K. Tamura and J. Tajima

412 ***Technical note* Laboratory simulation of thin slab casting**
M. D. C. Sobral, P. R. Mei, R. G. Santos, F. C. Gentile, and J. C. Bellon

429 **Towards coal based continuous steelmaking**
**Part 1 – Iron ore fines and scrap to low carbon steel by melt circulation**
N. A. Warner

435 **Towards coal based continuous steelmaking**
**Part 2 – Low carbon to ultralow carbon steel**
N. A. Warner

441 **Desulphurisation of high sulphur coal to improve industrial utilisation**
J. Pal, M. C. Goswami, Manjeet Singh and K. K. Singh

447 **Influence of nature and particle size distribution on granulation of iron ore mixtures used in a sinter strand**
A. Formoso, A. Moro, G. Fernández Pello, J. L. Menendéz, M. Muñiz and A. Cores

461 **Investigation and technological optimisation of iron ore bedding and blending process**
X. Bi, G. Zhou, W. Xiong, S. Zhang, Z. Yao, W. Zhang and G. Wang

467 **Theoretical consideration of problems relating to high coal rate injection into blast furnaces**
S. Zhang and X. Bi

475 **A solid flow model for blast furnace based on hypo-plasticity theory**
S. A. Zaïmi, J.-B. Guillot and H. Biausser

483 **Effect of directly reduced iron on alumina activity in electric arc furnace slags**
M. Meraikib

487 **Formation of oxide inclusions during deoxidation and solidification of high purity steels**
S. Ovtchinnikov, S. Kazakov and D. Janke

497 **Optimisation of pinch roll load in thin slab continuous casting**
L. S. Bayoumi and G. M. Megahed

503 **Design of corners of mould in square billet casting**
C. Mapelli and S. Semplici

511 **Minimisation of slag entrapment and cold drops in Sidetur billets**
B. Santillana, M. Dziuba, J. Madías, M. Ortopeza and E. Fernádez

---

**News and views** pages **1, 82, 177, 257, 337, 417**

**Conference reports**

5 **Industry–university partnerships in materials engineering**

82 **4th European Continuous Casting Conference**

179 **23rd ATS Steelmaking Conference**

191 **Challenges in reheating furnaces**

421 **4th European Oxygen Steelmaking Conference**

**International conference diary** pages **10, 194, 264, 340, 428**